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1 [Converter and communication circuits: A 120nm low power asynchronous ADC](#)

E. Allier, J. Goulier, G. Sicard, A. Dezzani, E. André, M. Renaudin

 August 2005 **Proceedings of the 2005 international symposium on Low power electronics and design ISLPED '05**

Publisher: ACM Press

Full text available: [pdf\(3.65 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper discusses the development of a new kind of low power processing chain which dynamically adapts sampling frequency to signals. Thus, the design of an Asynchronous Analog-to-Digital Converter (A-ADC) is tackled. Its principle is based on a non-uniform sampling scheme and asynchronous technology, that allow significant activity and power savings. A test chip targetting 10-bit speech applications has been fabricated using the 120nm CMOS process from STMicroelectronics. The power consumpti ...

Keywords: analog-to-digital conversion, asynchronous technology, level-crossing sampling

2 [Undergraduate embedded system education at carnegie mellon](#)

Philip Koopman, Howie Choset, Rajeev Gandhi, Bruce Krogh, Diana Marculescu, Priya Narasimhan, Joann M. Paul, Ragunathan Rajkumar, Daniel Siewiorek, Asim Smailagic, Peter Steenkiste, Donald E. Thomas, Chenxi Wang

 August 2005 **ACM Transactions on Embedded Computing Systems (TECS)**, Volume 4 Issue 3

Publisher: ACM Press

Full text available: [pdf\(162.46 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Embedded systems encompass a wide range of applications, technologies, and disciplines, necessitating a broad approach to education. We describe embedded system coursework during the first 4 years of university education (the U.S. undergraduate level). Embedded application curriculum areas include: small and single-microcontroller applications, control systems, distributed embedded control, system-on-chip, networking, embedded PCs, critical systems, robotics, computer peripherals, wireless data ...

Keywords: Embedded systems education, curriculum

3 [Reviewed articles: Achieving sub-second IGP convergence in large IP networks](#)

Pierre Francois, Clarence Filsfils, John Evans, Olivier Bonaventure

 July 2005 **ACM SIGCOMM Computer Communication Review**, Volume 35 Issue 3

Publisher: ACM Press

Full text available: [pdf\(163.62 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We describe and analyse in details the various factors that influence the convergence time of intradomain link state routing protocols. This convergence time reflects the time required by a network to react to the failure of a link or a router. To characterise the convergence process, we first use detailed measurements to determine the time required to perform the various operations of a link state protocol on currently deployed routers. We then build a simulation model based on those measuremen ...

Keywords: IS-IS, OSPF, convergence time, intradomain routing

4 Session 9: operating systems: System noise, OS clock ticks, and fine-grained parallel applications 

Dan Tsafrir, Yoav Etsion, Dror G. Feitelson, Scott Kirkpatrick

June 2005 **Proceedings of the 19th annual international conference on Supercomputing ICS '05**

Publisher: ACM Press

Full text available:  pdf(396.20 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

As parallel jobs get bigger in size and finer in granularity, "system noise" is increasingly becoming a problem. In fact, fine-grained jobs on clusters with thousands of SMP nodes run faster if a processor is intentionally left idle (per node), thus enabling a separation of "system noise" from the computation. Paying a cost in average processing speed at a node for the sake of eliminating occasional processes delays is (unfortunately) beneficial, as such delays are enormously magnified when one ...

Keywords: HPC, modeling system noise, operating systems, smart timers, synchronization, ticks, timer interrupts, timing services

5 Software design patterns for TinyOS 

David Gay, Phil Levis, David Culler

June 2005 **ACM SIGPLAN Notices , Proceedings of the 2005 ACM SIGPLAN/SIGBED conference on Languages, compilers, and tools for embedded systems LCTES'05**, Volume 40 Issue 7

Publisher: ACM Press

Full text available:  pdf(372.58 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present design patterns used by software components in the TinyOS sensor network operating system. They differ significantly from traditional software design patterns due to the constraints of sensor networks, and to TinyOS's focus on static allocation and whole-program composition. We describe how nesC has evolved to support these design patterns by including a few simple language primitives and optimisations.

Keywords: TinyOS, design patterns, embedded systems, nesC

6 Preventing interrupt overload 

John Regehr, Usit Duongsaa

June 2005 **ACM SIGPLAN Notices , Proceedings of the 2005 ACM SIGPLAN/SIGBED conference on Languages, compilers, and tools for embedded systems LCTES'05**, Volume 40 Issue 7

Publisher: ACM Press

Full text available:  pdf(291.66 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Performance guarantees can be given to tasks in an embedded system by ensuring that access to each shared resource is mediated by an appropriate scheduler. However, almost all previous work on CPU scheduling has focused on thread-level scheduling, resulting in systems that are vulnerable to a lower-level form of overload that occurs when too many interrupts arrive. This paper describes three new techniques, two software-based and one hardware-based, for creating systems that delay or drop excess ...

Keywords: embedded, interrupts, overload, scheduling

7 An Ultra Low Power System Architecture for Sensor Network Applications

Mark Hempstead, Nikhil Tripathi, Patrick Mauro, Gu-Yeon Wei, David Brooks

June 2005 **Proceedings of the 32nd Annual International Symposium on Computer Architecture ISCA '05**

Publisher: IEEE Computer Society

Full text available:  [pdf\(332.56 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Recent years have seen a burgeoning interest in embedded wireless sensor networks with applications ranging from habitat monitoring to medical applications. Wireless sensor networks have several important attributes that require special attention to device design. These include the need for inexpensive, long-lasting, highly reliable devices coupled with very low performance requirements. Ultimately, the "holy grail" of this design space is a truly untethered device that operates off of energy sc ...

8 Transport 2: Reliable bursty convergecast in wireless sensor networks

 Hongwei Zhang, Anish Arora, Young-ri Choi, Mohamed G. Gouda

May 2005 **Proceedings of the 6th ACM international symposium on Mobile ad hoc networking and computing MobiHoc '05**

Publisher: ACM Press

Full text available:  [pdf\(637.39 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We address the challenges of bursty convergecast in multi-hop wireless sensor networks, where a large burst of packets from different locations needs to be transported reliably and in real-time to a base station. Via experiments on a 49 MICA2 mote sensor network using a realistic traffic trace, we determine the primary issues in bursty convergecast, and accordingly design a protocol, RBC (for Reliable Bursty Convergecast), to address these issues: To improve channel utilization and to reduce ack ...

Keywords: bursty convergecast, contention control, error control, reliable and real-time transport, wireless sensor network

9 A Comparison of Multicast Feedback Control Mechanisms

Shuju Wu, Sujata Banerjee, Xiaobing Hou

April 2005 **Proceedings of the 38th annual Symposium on Simulation**

Publisher: IEEE Computer Society

Full text available:  [pdf\(184.56 KB\)](#) Additional Information: [full citation](#), [abstract](#)

In reliable multicast applications, packet loss needs to be reported by having group members send feedback messages. This results in the well-known feedback implosion problem. The available feedback control mechanisms can be classified as timer-based, hierarchy-based and router-assisted, among which the timer-based approach is more preferable due to its simplicity and flexibility. This paper compares the performance of a set of multicast protocols that use either the traditional timer-based feed ...

10 Collecting and Exploiting High-Accuracy Call Graph Profiles in Virtual Machines

Matthew Arnold, David Grove

March 2005 **Proceedings of the international symposium on Code generation and optimization CGO '05**

Publisher: IEEE Computer Society

Full text available:  [pdf\(238.98 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Due to the high dynamic frequency of virtual method calls in typical object-oriented programs, feedback-directed devirtualization and inlining is one of the most important optimizations performed by high-performance virtual machines. A critical input to effective feedback-directed inlining is an accurate dynamic call graph. In a virtual machine, the dynamic call graph is computed online during program execution. Therefore, to maximize overall system performance, the profiling mechanism must stri ...

11 Software engineering: applications, practices and tools (SE): A pattern-based development methodology for communication protocols



YoungJoon Byun, Beverly A. Sanders

March 2005 **Proceedings of the 2005 ACM symposium on Applied computing**

Publisher: ACM Press

Full text available: [pdf\(137.82 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Patterns help to improve software quality and reduce development cost by documenting the experience of experts so that good solutions to recurring problems can be reused. In this paper, we propose a pattern-based software development methodology for communication protocols, particularly focusing on the specification and validation of message interactions. For the description of communication protocols, we propose a set of patterns. A complex protocol can be obtained by composing such patterns. T ...

Keywords: SPIN model checker, communication protocols, design pattern, development methodology, pattern language

12 Simulation: A system for simulation, emulation, and deployment of heterogeneous sensor networks



Lewis Girod, Thanos Stathopoulos, Nithya Ramanathan, Jeremy Elson, Deborah Estrin, Eric Osterweil, Tom Schoellhammer

November 2004 **Proceedings of the 2nd international conference on Embedded networked sensor systems**

Publisher: ACM Press

Full text available: [pdf\(345.48 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Recently deployed Wireless Sensor Network systems (WSNs) are increasingly following *heterogeneous* designs, incorporating a mixture of elements with widely varying capabilities. The development and deployment of WSNs rides heavily on the availability of simulation, emulation, visualization and analysis support. In this work, we develop tools specifically to support *heterogeneous* systems, as well as to support the measurement and visualization of *operational* ...

Keywords: EmStar, TinyOS, real code simulation, sensor networks

13 Network security: Web tap: detecting covert web traffic



Kevin Borders, Atul Prakash

October 2004 **Proceedings of the 11th ACM conference on Computer and communications security**

Publisher: ACM Press

Full text available: [pdf\(129.06 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

As network security is a growing concern, system administrators lock down their networks by closing inbound ports and only allowing outbound communication over selected protocols such as HTTP. Hackers, in turn, are forced to find ways to communicate with compromised workstations by tunneling through web requests. While several tools attempt to analyze inbound traffic for denial-of-service and other attacks on web servers, Web Tap's focus is on detecting attempts to send significant amounts of ...

Keywords: HTTP, anomaly detection, covert channels, intrusion detection, spyware detection, tunnels

14 An ultra low-power processor for sensor networks



Virantha Ekanayake, Clinton Kelly, Rajit Manohar

October 2004 **ACM SIGOPS Operating Systems Review , ACM SIGARCH Computer Architecture News , ACM SIGPLAN Notices , Proceedings of the 11th**

international conference on Architectural support for programming languages and operating systems ASPLOS-XI, Volume 38 , 32 , 39 Issue 5 , 5 , 11

Publisher: ACM Press

Full text available:  [pdf\(437.23 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We present a novel processor architecture designed specifically for use in low-power wireless sensor-network nodes. Our sensor network asynchronous processor (SNAP/LE) is based on an asynchronous data-driven 16-bit RISC core with an extremely low-power idle state, and a wakeup response latency on the order of tens of nanoseconds. The processor instruction set is optimized for sensor-network applications, with support for event scheduling, pseudo-random number generation, bitfield operations, and ...

Keywords: asynchronous, event-driven, low-energy, picojoule computing, sensor network processor, sensor networks, wireless

15 Performance analysis for a new medium access control protocol in wireless LANs 

Younggoo Kwon, Yuguang Fang, Haniph Latchman

September 2004 **Wireless Networks**, Volume 10 Issue 5

Publisher: Kluwer Academic Publishers

Full text available:  [pdf\(301.06 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

One fundamental issue in high-speed wireless local area networks (LANs) is to develop efficient medium access control (MAC) protocols. In this paper, we focus on the performance improvement in both MAC layer and transport layer by using a novel medium access control protocol for high-speed wireless LANs deploying carrier sense multiple access/collision avoidance (CSMA/CA). We first present a recently proposed distributed contention-based MAC protocol utilizing a Fast Collision Resolution (FCR ...

Keywords: IEEE 802.11, TCP, UDP, medium access control (MAC), wireless LANs (WLANS)

16 Wireless and sensor: Computation in networks of passively mobile finite-state 

 **sensors**

Dana Angluin, James Aspnes, Zoë Diamadi, Michael J. Fischer, René Peralta

July 2004 **Proceedings of the twenty-third annual ACM symposium on Principles of distributed computing**

Publisher: ACM Press

Full text available:  [pdf\(223.67 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We explore the computational power of networks of small resource-limited mobile agents. We define two new models of computation based on pairwise interactions of finite-state agents in populations of finite but unbounded size. With a fairness condition on interactions, we define the concept of stable computation of a function or predicate, and give protocols that stably compute functions in a class including Boolean combinations of threshold- k , parity, majority, and simple arithmetic. We ...

Keywords: diffuse computation, finite-state agent, intermittent communication, mobile agent, sensor net, stable computation

17 Discrete event fluid modeling of background TCP traffic 

 **David M. Nicol, Guanhua Yan**

July 2004 **ACM Transactions on Modeling and Computer Simulation (TOMACS)**, Volume 14 Issue 3

Publisher: ACM Press

Full text available:  [pdf\(820.67 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

TCP is the most widely used transport layer protocol used in the Internet today. A TCP session adapts the demands it places on the network to observations of bandwidth

availability on the network. Because TCP is adaptive, any model of its behavior that aspires to be accurate must be influenced by other network traffic. This point is especially important in the context of using simulation to evaluate some new network algorithm of interest (e.g., reliable multicast) in an environment where the bac ...

Keywords: TCP, Traffic modeling

18 Streaming: An adaptive multiple retransmission technique for continuous media streams



Rishi Sinha, Christos Papadopoulos

June 2004 **Proceedings of the 14th international workshop on Network and operating systems support for digital audio and video**

Publisher: ACM Press

Full text available: [pdf\(231.30 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Retransmission can be used for loss recovery in continuous media applications but the number of retransmission attempts is bounded by the size of the playout buffer. For efficient recovery, a protocol must attempt as many retransmissions as possible but avoid late retransmissions. This typically requires that the playout buffer be sized in round-trip time (RTT) multiples plus some margin for error. RTT-based timers are then used to trigger retransmissions. However, this approach is problematic d ...

Keywords: continuous media, retransmission, streaming

19 Wireless sensor networks: Intelligent fluid infrastructure for embedded networks



Aman Kansal, Arun A. Somasundara, David D. Jea, Mani B. Srivastava, Deborah Estrin

June 2004 **Proceedings of the 2nd international conference on Mobile systems, applications, and services MobiSys '04**

Publisher: ACM Press

Full text available: [pdf\(401.74 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Computer networks have historically considered support for mobile devices as an extra overhead to be borne by the system. Recently however, researchers have proposed methods by which the network can take advantage of mobile components. We exploit mobility to develop a fluid infrastructure: mobile components are deliberately built into the system infrastructure for enabling specific functionality that is very hard to achieve using other methods. Built-in intelligence helps our system adapt to run ...

Keywords: controlled mobility, data gathering, mobile router, sensor networks

20 Energy conservation for mobile devices: Sleep: a technique for reducing energy consumption in handheld devices



Lawrence S. Brakmo, Deborah A. Wallach, Marc A. Viredaz

June 2004 **Proceedings of the 2nd international conference on Mobile systems, applications, and services MobiSys '04**

Publisher: ACM Press

Full text available: [pdf\(227.79 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Energy management has become one of the great challenges in portable computing. This is the result of the increasing energy requirements of modern portable devices without a corresponding increase in battery technology. *uSleep* is an energy reduction technique for handheld devices that is most effective when the handheld's processor is lightly loaded, such as when the user is reading a document or looking at a web page. When possible, rather than using the processor's idle mode, *uSleep* tri ...

Keywords: energy management, power management, processor sleep

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